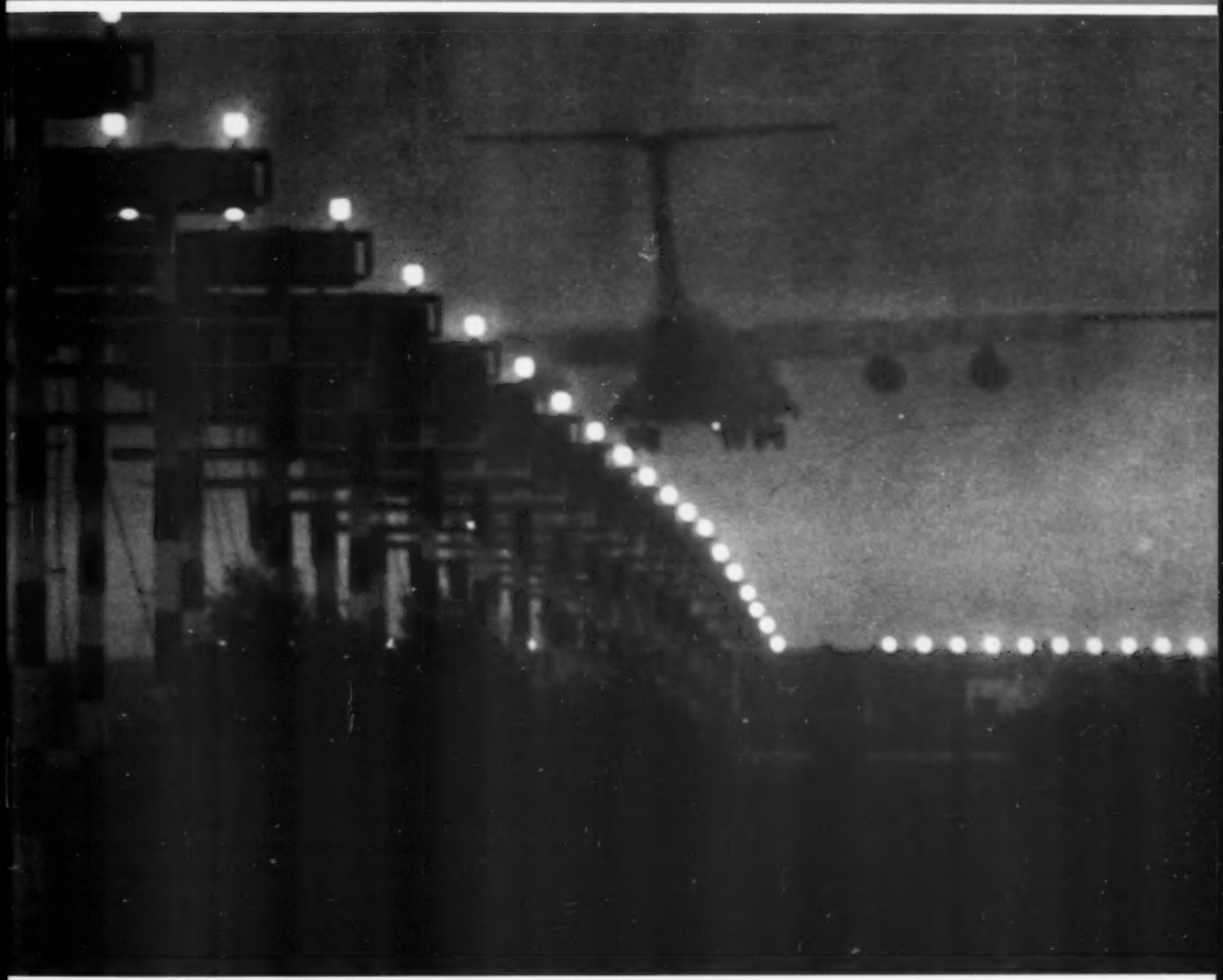
The MAC Flyer

NOVEMBER 1973



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The MAC Flyer

For Greater Efficiency
in MAC Air Operations

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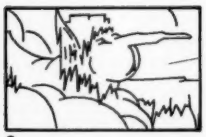

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COVER: Winter's on its way — and with it comes low visibilities, more hours of darkness, snow, ice, and other hazards.

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A FLYER Comment
This is Your Pilot Speaking

by Maj John W. Ray, Supervising Editor

Younger MAC pilots may never have seen it, but there once existed a document entitled "Transport Pilot's Code" and anyone who ever stepped into the crew compartment of a "MATS" aircraft of the early 1960's couldn't help but notice it.

The code was always posted in a conspicuous spot to remind pilots of their responsibilities. Later it was changed to "MATS Pilot Code" and around 1968 became "MAC Crew Member Code." It's a relic of the past, now, although some of the later posters might still be fading today in some of MAC's older machines.

The old code originated during the days when the Military Air Transport Service meant transporting thousands of passengers as well as tons of cargo. Families routinely flew overseas on PCS moves in the MAC aircraft of those days, a fact that had a lot to do with the code's inception.

MAC crews at one time rather jokingly divided themselves into "dirty MATS" for those transporting cargo and "clean MATS," if they happened to be members of a passenger flying unit. But the days of extensive passenger hauling have long since given way to commercial airline contract carriers. Today, MAC airlift consists primarily of cargo hauling. Passenger runs are rather unusual except in the 89th MAW, and most of the personnel flying MAC usually are on a space-available status.

But the MAC pilots of another day hauled thousands of personnel and did subscribe to that special code for transport pilots.

Actually, the "Transport Pilot's Code" was simply an affirmation of awareness, an acknowledgement that human cargo is a far more precious commodity than a plane load of mail, army trucks, or GCA equipment. A logical assumption was that pilots flying passengers would exercise that extra, infinitesimal bit of judgment and caution which might mean the difference between taking an unnoticed risk or playing it completely safe.

This presumption brings up a challenging question. Do pilots with passengers aboard their aircraft take fewer chances than those who fly single-place aircraft or aircraft carrying only themselves and their crews?

Obviously, risk is more inherent in some types of flying than in others. Consider a fighter mission, for example. Simply practicing some of their high performance tactical maneuvers may actually be more risky than flying a really tough transport mission. But, then, this risk is inherent in the job. It is necessary and, to a point, accepted; and, too, the crew on a fighter never numbers more than two and often only one and they have accepted all risks involved in their jobs.

So, back to the original question. Do pilots of such aircraft "inherently" use less caution than those flying transports with passengers aboard? Attempting to answer this question rationally would be like trying to determine whether Eddie Rickenbacker were a better pilot than Charles Lindbergh. Such flying environments vary too drastically to draw valid conclusions. Without delving into other factors, the comparison just doesn't compute.

Yet, just as more pronounced risks are innate to other types of aircraft and their missions, there is inherent in airlift flying an implied promise which materializes the moment a passenger steps into the cabin. The pilot and his crew are at that instant promising they will do everything humanly possible to bring the flight to a safe conclusion, and that there will be no lapse whatsoever in the pilot's awareness of this commitment.

This implication is over and above the mute understanding which is ever present between crew members. And it persists whether a passenger load consists of a half dozen, dog-tired G.I.s trying to get home for Christmas or 10 families on an evacuation flight out of some Southeast Asia hot spot.

Perhaps not all MAC pilots are consciously aware of this pledge. But passengers are. So are their families and friends, none of whom is ever likely to know your name. You may have felt this same awareness if you've ever boarded an airliner with your family.

Well, perhaps there is no longer a need for a pilots' or crew members' code or anything approaching it. It could be that very few paid any attention to it, anyway.

But all the pilots I have known personally, from the C-118 days to the present, would go to great lengths before considering an action which could break that promise to their passengers.

One peak may be worth a thousand cross-checks, but don't try it when you're waiting for...

"One Hundred Above—Land"

by Capt A. R. Barbin, Associate Editor

Low visibility approaches confront aircrews throughout the world every day. At this very instant, a MAC aircraft commander or his civilian counterpart is guiding his aircraft at speeds up to 230 feet per second through moisture blankets toward an obscured runway. If he does sight the runway at or near decision height, the pilot will have to decide instantly whether a safe landing is possible. Then, he'll have only a few seconds to translate visual cues into control adjustments before touchdown.

Approaches through weather minimums to a safe touchdown are routinely flown by MAC and commercial pilots. Yet, inattention, overconfidence, and lack of cockpit discipline account each year for tragedies during weather approaches. Pilots ignoring their instruments for distorted visual references or attempting to duck under ceilings to take a peek have caused numerous mishaps in spite of the highly sophisticated and responsive cockpit instrumentation available.

* * *

All higher forms of animal life reference their position on earth to some type of datum, normally the horizon. People, and pilots in particular, are no exception. Removal or distortion of natural references often causes spatial disorientation, one of flying's most common hazards. To enable pilots to fly in weather, refined artificial references have been created to replace natural elements. But humans tend to reject most artificial inputs, whether they take the form of an artificial organ, limb, or visual reference. To overcome this natural tendency, pilots must discipline themselves to trust artificial visual references and translate them into precise, safe IFR recoveries.

The goal of every weather approach is to get the airplane safely on the runway. Pilots, who break out at decision height consistently on the money with the runway at 12 o'clock, are the envy of their fellow pilots. The difference between such precision and a go-around often is that professional pilots discipline themselves to organize duties before initiating a weather approach.

Preparation

Flight planning during marginal weather should begin before takeoff and be reaffirmed throughout the flight prior to descent. A detailed mental picture of the entire instrument approach procedure and runway environment should be firmly implanted in the pilot's mind well before he initiates it. Locations of navigational aids, the type of approach lighting, minimums, time and distances from the final approach fix (FAF) to the missed approach point (MAP), glide slope angle, sector altitudes, headings, missed approach procedures, and obstructions are just a few items with which a pilot should become intimately familiar. This enables him to fully concentrate on instrument interpretation and the me-

chanical execution of the approach. ILS final is neither the place nor time to start groping for a vital piece of information. Get it all together before you start down the chute.

The time to organize crew and cockpit for any approach is prior to enroute descent. Pilot workload increases significantly once initial descent begins. Study terminal area charts and approach plates and have them available. Crew briefings, descent checklists, and command post calls should be gotten out of the way well before the approach begins. The goal is to accomplish as much as possible before the initial descent.

In many high density areas, a pilot is confronted with an aeronautical rat race from initial descent to landing rollout. A jungle of amended clearances, radar vectors, ARTC advisories, handoffs, and sequencing will place an ill-prepared and disorganized crew at a distinct disadvantage. An overloaded crew cannot devote full attention to a descent and is unlikely to effectively handle a rapid sequence of events. The result will probably be a poorly executed approach.

Initial configuration for most MAC aircraft is recommended just after passing the initial approach fix outbound or on downwind for a radar pattern. This is the time and place to ready the bird for final. Get the aircraft configured in accordance with your Dash One, navigational equipment checked, command markers set, and any approach variations briefed. Get as much of the workload accomplished as possible before intercepting glide slope. This will allow you to concentrate on flying the course and glide path.

Staying on course and on the glide slope requires a great deal of concentration. If this concentration is interrupted by late checklists, tardy configuration changes or other distractions, it is likely that the remainder of the approach will be less than precise and possibly even unsafe if continued.

Knowledge

Instrument presentations can be deceiving unless the pilot knows exactly what the instrument is telling him. For example, a course deviation indicator displaced one dot on an ILS approach indicates a displacement of one and one-fourth degrees. This angular displacement may seem insignificant but it translates into some surprising distances. At three miles it comes to 573 feet; at one mile, 308 feet; and at one-half mile, 252 feet. Similarly, vertical deviations of one dot below glide slope (one-fourth of a degree) at the same points equate to 78, 26 and 13 feet below the glide path. With these situations existing at minimums (with aircraft approach speed at 135 knots in a no-wind condition), the pilot will have 11 seconds or less to integrate visual cues into control inputs and land. A lot of unnecessary and unsafe yanking and banking can be avoided on short final if course and glide slope are precisely followed. Know exactly what your instruments are telling you and make every effort to wire the glide slope and localizer several miles out.

Your rate of descent is an excellent planning tool for ILS and PAR approaches. A known rate of descent allows a smooth transition from level flight to descent during glide slope capture. It also assists in minimizing glide slope deviations throughout the approach. Accurate vertical velocity information may be predicted in advance of the approach. All you need to predict your vertical velocity is an approach speed, the glide path angle, and a letdown book. DOD letdown books contain rates of descent for corresponding glide path angles and ground speeds. For example, a 2.5 degree ILS glide slope flown at 120 knots (ground speed) requires a 530-foot-per-minute rate of descent. Equipped with this knowledge, a pilot can smoothly decrease pitch until the desired vertical velocity is attained. Cross-checking vertical velocity throughout a precision approach will help maintain a stable glide rate and proper aircraft attitude.

Sensitivity Problems

Instrument sensitivity due to course convergence is a factor that often causes rather wild gyrations by pilots who waited too late to establish themselves well on the glide slope and localizer. That CDI displacement of one dot at three miles was 573 feet; now, at just a half mile, the one dot means 252 feet. But trying to come back on course at a half mile out, just about time for minimums, is going to cause a much greater problem because of the instrument's sensitivity and your lower altitude and proximity to the runway. In short, all hell is breaking loose at the same time, and at the worst possible time at that. So, get on course and glide

The world reduced to instruments.

path far enough out to prevent all the fuss. Smooth, precise bank and pitch inputs are a must in this narrowing course and glide path spectrum. Normally, five degrees of bank and two degrees of pitch are enough for small adjustments.

Glide path cross-check is a must during the last few seconds.

Meteorological Illusions

Beware of reported visibilities and ceilings. Even with a valid weather forecast, breakout may not occur as predicted. The reason for this is slant range visibility. The weatherman bases his observations on vertical and horizontal sightings from the field and your aircraft is going to approach from a different angle and direction. So expect to sight the runway environment at a lower altitude than might have been predicted.

Weather often produces convincing illusions. Combinations of layered cloud decks, ragged cloud definition, ground lighting, precipitation, and crosswinds can produce eerie backgrounds and raise havoc with pilot spatial orientation. Lights reflecting off or through cloud formations can be most distracting during night instrument approaches, often causing a pilot's peripheral vision to lock on to a false horizon, producing vertigo. During low visibility approaches, the pilot must discipline his cross-check to the instruments and fight against deceptive illusions. This may be tough but reliance on instruments is the only sure way to guide an aircraft through weather to a safe landing. Illusions caused by weather and reflecting lights often cause a pilot to think his aircraft is higher than it is. Consequently, adherence to ILS, GCA, and VASI glide slope information is essential throughout transition to touchdown. Since glide slope information is not subject to distortion, it is the pilot's sole insurance against visual misinterpretation.

So when your copilot states "land" at decision height, don't forsake your instruments for the security blanket of a sighted runway. Many pilots have pruned trees, mangled approach lighting, or crashed short of the runway at this critical point. One of the most critical phases of flight other than during an inflight emergency occurs just after breaking out at minimums during visual transition to landing. Even after the runway environment has been sighted, the pilot is far from home free.

The instruments within his few square feet of reference are the pilot's only visual link with an obscured runway. He must ensure his systematic cross-check of control and performance instruments is unbroken and the natural urge to look out the window does not cause him to drop below the glide path.

Consider the situations that undermine pilot attentiveness during precision final: incomplete checklists, late configuration changes, and mis-set navigational equipment. These factors may interfere significantly with the precise execution of the last, most critical leg of the mission. Compression of preparatory cockpit duties in an increasingly sensitive instrument envelop will sap a pilot's concentration and cause less than precise adherence to final course and glide path.

Don't Rush

Whether or not you prepared yourself ahead of time, don't let yourself get rushed. A jet transport at low power, in a high drag configuration, descending at excessively high rates on an ILS or GCA final, is an accident waiting to happen. Yet, pilots sometimes accept hurried radar vectors close to or inside the final approach fix or descent point. Such positioning usually causes glide slope intercept from above and compounds pilot workload. In such cases, excessively high descent rates are required for glide path intercept and several miles may be covered before intercept is completed. The hazard in this is the possibility of knifing through the glide slope and ending up well below it on short final.

Precise execution of instrument approaches requires much practice, a commodity that has become less than plentiful due to economic austerity. So take advantage of every chance you get to practice your art. Hone up on the techniques, discipline, and skill required for that low visibility approach in your future. Pilots who discipline themselves to plan, organize, and execute each instrument approach with systematic precision are unlikely to experience an accident or incident short of the runway.

Global Notes

ice cap rescue

Two 67th ARRS paramedics have made the first known parachute jumps on the Greenland ice cap, a feat which resulted in a successful rescue effort. Sgts Tim Goldschmidt and Gary Wasmer jumped from a HC-130 to assist an injured civilian pilot who was trapped in the cockpit of his wrecked aircraft. The sergeants removed the pilot from the wreckage and a Greenland civilian helicopter made the pickup.

Their jumps marked the end of a five-day flight in which their HC-130 helped save the lives of five persons.

The action began when their Hercules was launched for in-flight refueling of an HH-3E Jolly Green Giant helicopter over the ice cap. The Jolly Green was transporting two critically ill Danish civilians to a hospital in South Greenland.

After that mission, the HC-130 landed at Sondrestrom AB, its crew intending to return to Iceland the following day. Before departing, the crew learned that a two-man powered glider was missing. The Jolly Green and Hercules again collaborated and this time rescued the two downed glidermen from an off-shore island.

On the fifth day, the crew located the wreckage of an American-made amphibian aircraft on the surface of a glacier. There was no sign that the pilots had left the aircraft. It was at this time that Sgts Goldschmidt and Wasmer made their jumps.

The Hercules aircraft, on temporary duty at Keflavik, was deployed from the 67th Aerospace Rescue and Recovery Squadron at Woodbridge, England.

Jolly Green to the rescue off Greenland coast. (U.S. Navy photo)

long-range rescue

A recent life-saving mission involved four Air Force aircraft and their crews as a helicopter and three fixed-wing craft teamed up in a dramatic open-sea pickup and long-range medical evacuation of a Navy seaman.

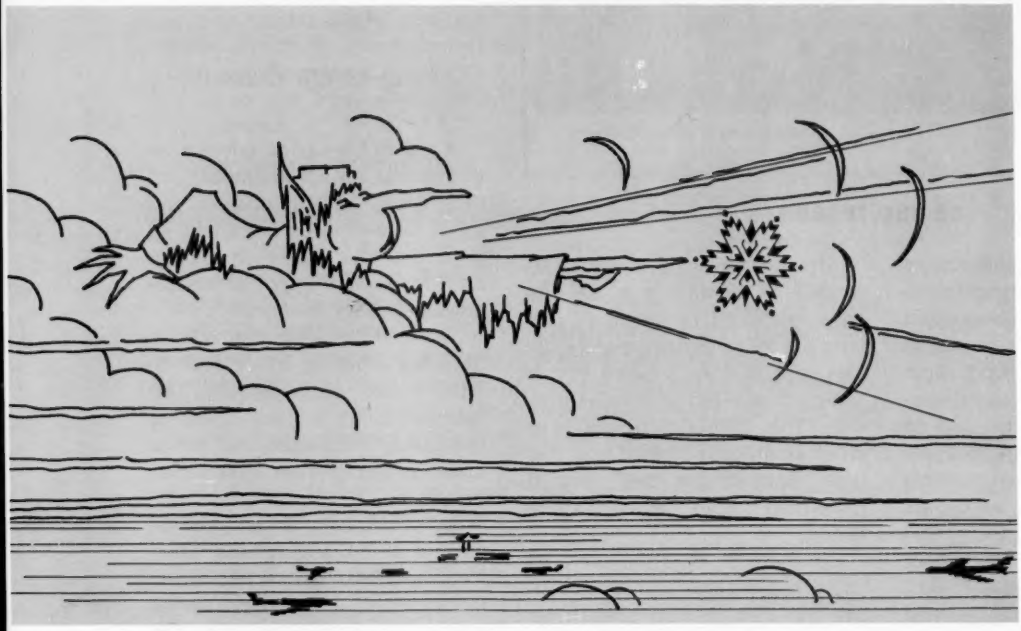
The call for help came on a Saturday morning when a U. S. Navy vessel, approximately 100 nautical miles off the coast of Iwo Jima, requested aid for a sailor suffering from intercranial bleeding.

An HH-3E Jolly Green helicopter and an HC-130 refueler from the 33d ARRS, Kadena AB, Okinawa, immediately launched on the long-range recovery. An additional HC-130 was dispatched by the 31st ARRS from Clark AB, Philippines, to assist. The '130s provided the helicopter with two in-flight refuelings.

After locating the Navy ship, the helicopter, commanded by Maj Donald Skinner, hovered over the vessel while pararescueman SSgt Randall S. Carmichael was lowered on the hoist. Sgt Carmichael placed the ailing seaman into a litter basket which was then hoisted into the helicopter. The ship's doctor and Sgt Carmichael were also retrieved via the hoist and all were returned to Iwo Jima. A C-9 Nightingale was standing by to evacuate the injured sailor to a U. S. Army hospital on Okinawa.

In accomplishing this recovery, one HC-130 covered nearly 1,700 nautical miles and the helicopter flew approximately 1,000 miles.

Ole Man Winter



by Maj Bob Gardner,
Associate Editor

Have you ever noticed the line of cars backed up at your local service station the morning after Ole Man Winter dumps his first blanket of snow of the season? Half of the world's drivers suddenly realize that they don't have a window scraper, haven't checked the anti-freeze, or still have the snow tires stashed away in the attic. Others find that the trusty old bomb that has taken them to work all summer and fall just won't turn over in subfreezing temperatures. Just watch — it happens every year.

You go to bed one night, having enjoyed a beautiful, balmy day, then awaken the next morning and your sidewalk, car, driveway, street, etc., are covered with six inches of the soft, fluffy, white stuff. Burrrrrr..... it sure looks cold outside. That light weight blue jacket isn't going to hack it today, you surmise. But after a cup of hot coffee to get you started, you clamber through the closet for the winter uniform you haven't worn since last March. And then you dig out the overcoat and gloves — if you can find them. Sound familiar? Obviously, these are just a few examples of not being prepared for the season at hand. And if you're not ready for cold weather at home, there is a good possibility something also is lacking in your preparation for winter flying.

Two important factors in combating the problems of winter are knowledge and planning. We all know, of course, that at this time of year the sun spends more of its time in the southern hemisphere. And, we are faced with more hours of darkness and lower temperatures. What really matters is how does the increased night time, colder air (and likewise cold tools, airplanes, fuel, oil, etc.), along with the associated snow, ice, low ceilings and visibility, bear on what we do and how we perform our jobs. What planning must we do to get ready for the consequences?

People Problems

Winter brings shorter periods of daylight. This means that more maintenance, preflights, towing, taxiing, and flying will take place within an environment of reduced outdoor lighting. Reduced visual perception increases the potential hazards associated with flying. Cold, gloomy days aren't likely to create a strong inclination for performing outside

tasks. None of us wants to spend a second longer than required outside in such conditions. Maintenance quality, supervision, and preflight inspections are all likely to be affected adversely. Proper dress and adequate lead time to perform tasks become very important in winter.

Creature comfort can play a big part in safe winter operations. Adequate protective clothing is just as important for the maintenance troops on the line as it is for the flight crew. Exposure of bare flesh to extremely cold metals and fluids can cause frostbite in a matter of seconds. The extra jobs created by winter also pose hazards requiring precautions. For example, condensation of moisture in fuel tanks can quickly create dangerous amounts of water. Sumps should be drained more often. Aircraft preheating becomes necessary and requires constant supervision and a fire extinguisher should be standing by.

A chilled body can also cool one's attitude. Add numbed fingers and it's easy for checklists to become abbreviated. So, remember this cardinal rule: Don't hurry the preflight! In bitter weather everyone is tempted to walk quickly around the airplane, hands in pockets, and shoulders hunched against the wind, and then hop aboard or hurry back to the warm flight-line shack. Resist that temptation. A lot can go wrong with a plane just standing on the ground in frigid winter conditions.

Preparation for any flight begins before you ever see the aircraft. This is even more important in winter. You should be fit, rested, and ready to fly. During this season, it is easier to catch a cold and other malaise, so your predeparture activities are important. Balanced meals and adequate sleep will go a long way in keeping you healthy.

Mission Planning

Start your flight planning early by requesting an extended weather forecast from the base weather station several days before your departure on a mission. Be aware that wind patterns shift with the seasons. The jet stream shifts to the south, increases in velocity, and drops to lower altitudes during the winter. If you're headed westbound, this can certainly mean shorter legs between fuel stops. Consider the terrain you'll be flying over as well, and if arctic survival gear is necessary, take it along. And just as important, be sure you know where it is and how to use it.

Spend some time studying destination and enroute airfields. You could have to make approaches in conditions of poor visibility. Snow on the ground may blot out or distort the appearance of many landmarks. While looking over the airfield layout, pay particular attention to obstructions which may present a hazard to flight or ground operations. You may have to circle to land around them.

If you know you are going places that have unusually severe weather, study the conditions you might encounter. Familiarize yourself with the hazards peculiar to the area so you can better cope with them. For example, in the far north and in Antarctica, whiteouts are common. And if you're a chopper pilot, a layer of light powdery snow churned up by the rotor wash can fix you up with a whiteout anywhere. Light in a whiteout is so perfectly reflected between cloud and snow that there are no shadows, no horizon, no surface definition, and no visible outlines by which to gage height or depth. Flying in a whiteout is like looking through a cloudy milk bottle and it can be a hairy situation if you're trying to land.

When filing your clearance, get a thorough weather check. This time you are interested in the current takeoff, en route, and forecast arrival conditions. Time en route, flight plan fuel, and reserves require critical calculations. Remember to request more gas for the higher power settings expected in icing conditions, traffic delays, and possible diversions due to changing terminal weather. Take a few extra minutes and compute crosswind and runway condition readings (RCR) effects. Give the notam file a careful check. There may be one or more runways closed at your destination because of snow or ice. Pilot reports and a first-hand chat with an incoming crew may provide some very valuable information.

Preflight and Ground Operations

Many of your cold weather problems will be encountered right on the ground. A cold soaked airplane that has spent the night outside needs a good going over. To ensure that your aircraft is ready in all respects, conduct a thorough preflight before you climb on board. All aircraft surfaces should be free of frost, ice, and snow. For you chopper jocks the same applies to those rotor blades. Any of these deposits can change the shape and aerodynamic characteristics of the airfoils, raising the stall speed and increasing takeoff roll. The only safe course is to deice. If you delay takeoff too long, you'll have to repeat the deicing procedure. Consider preheating a cold soaked airplane. Check

your plane's operating manual for proper procedures. Usually the engines, cockpits, avionics, hydraulic, and oil systems require warming. To prevent instrument damage, turn on instrument lighting and allow it to warm the gages.

Any areas where accumulations of ice, snow, slush, water, or even sand could cause operational difficulties, should be closely inspected. These include static ports, oleo struts, gear switches, steering components, all inlet ducts, exposed control mechanisms, and aerodynamic surfaces. Run your flight controls through a couple of times to make sure they aren't binding. Have a ground controller check their position for you. Check fuel vents for accumulations of packed snow or ice. Be sure to check strut extension and tires for proper inflation. Extreme cold temperatures may require reservicing them. Inspect fluid lines and seals for leaks and congealed fluids.

After the walk-around take one last look to ensure chocks are in place and wheels or skids (in the case of some helicopters) are not frozen to the ground. You are now ready to board up and make yourself at home in (hopefully) a nice warm cockpit. Engine start and runup require special precautions. Oil temperatures must be within specified limits and keep a watchful eye focused on the pressure and temperature gages. Cold, thick fluids just may not flow if they haven't been preheated enough. It's not uncommon for lines, hoses, and seals to give way. After the engines are running and the bird is putting out its own heat, things become more comfortable. But remember that the potential for problems on the ground isn't over yet.

Taxiing can be a real lulu on an icy surface. Keeping clear of other aircraft and obstacles gets tricky if guide lines are not discernible. The word is: taxi slow. Use brakes very, very gently and expect much longer stopping distances. Differential power may be necessary for turning.

Keep in mind that under certain conditions engine icing may occur on the ground, or shortly after takeoff, so the anti-icing procedures in your Dash One should be followed meticulously. If your air machine requires a runup, try to find a clean, dry spot to park. But under all conditions, head the airplane so that if it starts to move you've pavement in front of you rather than a ditch or snow bank.

Slip the Surly Bonds

If everything has checked out all right up to this point, you're now ready for takeoff. As you line up, keep in mind that directional control can be a problem during takeoff roll. Using braking for directional control until the rudders become effective can be particularly hazardous. A locked wheel skidding on ice can cause a blown tire, or even worse, a violent swerve, should it cross a dry spot on the runway. Above all, make sure the brakes aren't locked as you move off the takeoff spot. A few pilots have tried to get their big birds airborne this way, and have ended up plowing through the

approach lights at the far end of the runway. If there is snow, slush, or water on the runway, expect a longer takeoff roll.

After takeoff, if the conditions warrant, consider a slight delay before retracting the gear. This permits the slipstream to blow excess water and slush off the struts and landing gear. In addition, cycling the gear after retraction may prevent the doors from freezing shut. During climb don't forget that jet engine icing can form without signs of visible moisture, especially at high power settings and low air speeds. If ice forms on the inlet guide vanes, it causes a restriction to air flow. This may reduce thrust and lead to compressor stalls, flame out, and possible engine damage. An increase in exhaust gas temperature or a drop in engine pressure ratio (EPR) may be indications that ice has started to accumulate. If you must climb through altitudes where icing conditions exist, do so as rapidly as possible to minimize structural ice buildup. Remember, most aircraft have anti-icing rather than deicing systems. This means that they need to be on BEFORE entering icing conditions. Their function is to keep ice from accumulating; but they are not designed to remove ice already formed.

For you recip drivers, beware of the most treacherous of all ice — that which may accumulate in the carburetor. If the relative humidity of outside air is high, ice can form inside the carburetor in cloudless skies, even with the temperature as high as 25 degrees C (77 degrees F). It is most serious when the temperature and dew point approach 20 degrees C (68 degrees F), but pilots should be alert for it any time the relative humidity is high. Carburetor heat is the remedy. It preheats the air before it reaches the carburetor. Here again, carb heat is usually adequate to prevent icing, but it will not always clear ice which has already formed.

Bring Her Home

As you approach your destination, don't be too eager to accept an enroute descent unless you are sure that it will not result in excessive fuel consumption or prolonged flight in icing conditions. Know what you're descending into. Determine the weather, wind, and runway condition. Before commencing descent, ensure the defrosters are turned on in time to prevent window frosting during the letdown. Monitor the engine instruments carefully for any signs of induction icing.

Be prepared to locate the runway when you break out, bearing in mind that snow may mask or distort its appearance. Plan your touchdown point and landing speed carefully. A slow touchdown speed consistent with safe aircraft control is desirable. Since the landing surface most likely won't be a clean, dry, slab of concrete with the best coefficient of friction, be ready to employ aerodynamic drag, wheel braking, and reverse thrust to stop the aircraft. Wet, icy, or snow-covered surfaces will reduce braking efficiency dramatically, so take it easy on the brakes and use your flight manual procedures for slowing your big bird. One word of caution, excess reversing on light, powdery snow can put you IFR on the roll out.

When you have the aircraft under control, don't be too anxious to turn off the runway. Use extreme care in taxiing and keep it slow, making sure to remain on the taxiway and clear of all obstructions. This is where your knowledge of airfield layout (prior study) will be especially valuable. Watch out for the snow banks and be aware that personnel in earmuffs and parka hoods (whether driving or walking) aren't going to hear and see as well as normal.

After you've blocked in, remember to do those extra things required by the frigid outside air. If applicable, dilute the engine oil before shutting down. Drain any water from the fuel, oil, and other systems before it freezes. Then make sure all the protective covers are in place. If the plane will be sitting out for a long period in extreme conditions, check the Dash One for battery removal requirements.

Give Winter Some Thought

A lot of points about the hazards of winter and their effects on air operations have been addressed in this article. But, as always, it boils down to the same old fact — YOU have the responsibility and the authority to ensure safe handling of your aircraft, regardless of the season or weather. So don't let the darkness, cold temperatures, ice, snow, or bitter winds press you into a corner or catch you with your long johns down. With adequate preparation, many of the problems associated with winter can be minimized or eliminated entirely.

GOOD SHOW
MILITARY AIRLIFT COMMAND

Trying to steer a bicycle with no hands may be great sport, but finding yourself with that same feeling in an airplane is another situation.

Capt Ernest W. Elston and his navigator, Capt Walter H. Stevenson, Det 3, 9 Wea Recon Wg, Yokota Air Base, Japan, departed home station last summer in their long-winged, high altitude WB-57F for what they anticipated would be a routine navigation training flight. Approximately two hours into the mission, cruising at FL 450, Capt Elston attempted a turn using the aircraft autopilot. Experiencing negative response, he disconnected the autopilot and tried to manually bank the aircraft. The aircraft continued on its established course without the slightest indication of the intended turn.

An immediate evaluation determined that although the elevator and rudder operated normally, both ailerons were locked in a near neutral position. All corrective actions proved unsuccessful and an emergency was declared. A careful descent was then initiated. During the ensuing let-down into increased atmospheric density, extreme difficulty was encountered in maintaining a wings level attitude. This problem amplified to the extent that at 30,000 feet the aircraft was in a 45-degree bank. While exerting 200 to 400 pounds of force on the controls and employing his skill and knowledge, Capt Elston was able to keep the bank from increasing. The crew prepared for an ejection in case aircraft control wasn't attained prior to 15,000 feet. Once again the pilot exerted his maximum strength on the control column and finally the ailerons broke free as the aircraft passed through 20,000 feet. With questionable aileron response and poor weather at Yokota, the crew elected to recover at Kadena. A minimum maneuvering approach was initiated and the hectic flight terminated with a successful landing.

Post flight inspection revealed that a plugged drain hole in the bottom of number two engine cowling had trapped approximately two and a half gallons of water in the nacelle area where aileron control cables and pulleys are located. It is suspected that the accumulation of water froze due to the extreme low temperatures at flight altitude and locked the ailerons in their fixed position. No other obstruction or flight control malfunction was found.

In citing Captains Elston and Stevenson for their outstanding display of airmanship in this emergency situation, COMAC said, "The locking of the ailerons in a neutral position created a serious flight control problem. Your skillful and positive response to this emergency, one which is not covered in the Dash One, enabled you to maintain control of your aircraft until you could free the ailerons and make a safe recovery. Your excellent handling of the problem saved a valuable Air Force resource and prevented possible injury to you and your navigator. I congratulate you for your professional performance." To this THE MAC FLYER adds its "Good Show!"

Chopper pilots are familiar with main rotor droop. But little has been written on . . .

The Mystery of Tail Rotor Droop

by Capt A. R. Barbin,
Associate Editor

Unlike helicopter pilots, fixed wingers who have witnessed the ungraceful gyrations of a helicopter in autorotation or the deafening, pounding beat of its rotor, might have difficulty disassociating choppers from a Jules Verne creation.

But the welded-wingers (who've never experienced the joys of rotary wing flying) do seem to agree that somehow, by chance or sorcery, the main rotor creates lift and forward motion. Most aren't sure what the tail rotor is designed to do. But you veteran chopper pilots could easily enlighten your fixed-wing brothers about that little fan on the back.

Or could you?

Because the main rotor is your so-called stem of life, you helicopter pilots are pretty well versed on the aerodynamics of the big overhead prop and its associated problem situations — low rpm (droop) and blade stall. And most chopper jocks can give a rather detailed explanation of the normal functions of the tail rotor. But the subject of tail rotor operation during main rotor droop seems to be a more mysterious area into which few without aeronautical degrees seldom venture.

There are a number of reasons for this lack of understanding and the absence of taught or written material on the subject. To begin with, the relationship is somewhat complicated and its critical characteristics vary between helicopter type and model. And, too, actual flight test data under critical conditions is not available. Take the H-3 helicopter, for example. No flight tests to accurately measure tail rotor thrust effectiveness have been conducted, so Dash One limits and procedures are based on data compiled from test stand operations. During normal chopper operations, when main rotor rpm limits are maintained, tail rotor thrust and response are adequate and do not present a problem. In fact, it wasn't until after an H-3 accident last year that tail rotor ineffectiveness was recognized as a potential accident factor for this aircraft.

If you're not helicopter qualified and haven't been schooled in the principles of rotary wing flying, the following discussion on tail rotor-main rotor relationship may seem a bit too technical. But you chopper pilots should definitely follow with us. This information could help you avoid an incorrect decision during what only seems to be a tail rotor malfunction.

Basics

On American built, single rotor helicopters, the

The Mystery of Tail Rotor Droop

main rotor system rotates counterclockwise and the power applied to the main rotor generates torque, or twisting force, which tends to rotate the fuselage in the opposite direction. You learned this in helicopter training. The primary function of the tail rotor is to counter these effects of twisting force.

To counteract torque developed by the main rotor, the tail rotor is extended on a long arm (the tail boom) and driven at a much higher rpm than the main rotor. This is done through drive shaft linkage and gear boxes connected to the main rotor transmission. Tail rotor thrust output may be varied through directional (rudder) pedal displacement by the pilot. In this respect, the tail rotor also controls pivotal hover maneuvers and assists with in-flight turn coordination. An increase or decrease in engine power causes large variations in the torque produced. This force must be countered immediately with appropriate rudder inputs to keep the aircraft heading in the desired direction.

Should complete loss of tail rotor thrust occur during flight, the fuselage will start turning in the opposite direction of main rotor rotation. An out-of-control crash landing most likely will result. Many chopper drivers are self-conditioned to react spontaneously any time they apply maximum rudder pedal and get a less than expected response. Their first thought usually is that the tail rotor has malfunctioned. But this may not be the problem.

In one recent accident, the helicopter began an abrupt right turn during takeoff from a mountain landing zone. The pilot, assuming tail rotor control had been lost, reduced collective and crash landed. The investigation revealed no discrepancy with the tail rotor or related components. What, then, had caused the chopper to react as though tail rotor control had been lost? The answer is relatively simple; the main rotor rpm had decayed during the high power requirement on takeoff. This resulted in a corresponding tail rotor slowdown and, consequently, insufficient antitorque thrust to keep the nose of the helicopter from turning abruptly. This sudden increase of torque on the main rotor caused its drooping (low rpm) condition and was created by the pilot's drastic collective input on takeoff. The torque simply proved too much for the tail rotor (in its slowed condition) to counteract.

This mysterious phenomenon is called tail rotor ineffectiveness. It happens, as it did in this accident, when antitorque capabilities of the tail rotor are exceeded.

To explain how this out-of-balance condition between the main and tail rotor is created, a brief explanation is necessary on the relationship between power, torque, and engine response.

Power

Power demands of the main and tail rotor systems determine how much power is produced by the engine. Because of the mechanical link between the main rotor and tail rotor, power demands which exceed engine capability cause not only the main rotor rpm to droop, but that of the tail rotor as well. Severe droop results in loss of lift, high sink rates, and degraded directional control.

Torque

Torque is a moment of twisting force measured in foot pounds. Power is the rate of torque application measured in foot pounds per second. Torque and power are related; however, many pilots think that high torque indicates high power output from the engine. This is not always the case, and a clear distinction must be made between power and torque. A reduction in rotor rpm at high collective pitch settings does not result in any measurable loss in engine power or torque, but main rotor lift and tail rotor thrust decreases. This torque reaction of the main rotor causes the fuselage to turn right and the moment resulting from this torque must be countered by additional thrust from the tail rotor. To offset this the pilot depresses the left rudder pedal, increasing blade pitch which, in turn, increases tail rotor thrust. If the maximum blade limit of the tail rotor is attained, no further increase in tail rotor thrust is possible. Note that the tail rotor does not counteract power; it counteracts torque.

Droop and Engine Response

Decay of main rotor rpm (droop) and the corresponding partial or complete lack of tail rotor effectiveness is exaggerated during operations at high altitudes, high temperatures, and heavy gross weights. Decreased air density requires an increase in the angle of attack of the main and tail rotor blades. This causes high drag and increased power demand. Since the main rotor demands automatically regulate engine power output, the engine may be unable to provide enough power to meet main rotor power demands under the demanding conditions of high altitude, temperature, and weight. In such cases, with engine output at or near maximum, main and tail rotor rpm decreases, resulting

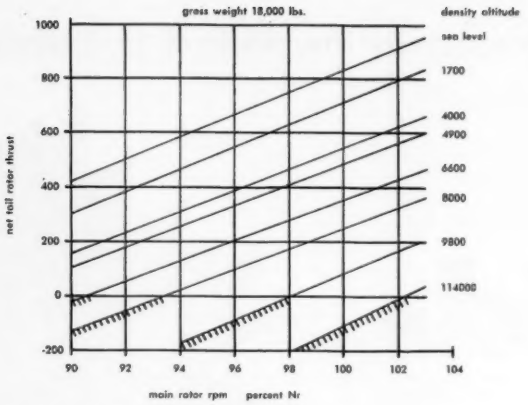


Fig. 1 Tail rotor thrust data.

in severe droop; thus tail rotor effectiveness decreases and the nose of the aircraft yaws right. If rudder corrections fail to halt this turning, the pilot's only choice is to unload the rotor blades and increase rotor rpm by decreasing collective inputs. This helps reduce aerodynamic loads on the main rotor blades and reduces power required and torque generation.

Rapid collective increases may also generate enough torque to exceed the antitorque capacity of the tail rotor. A sudden increase in collective could create an instantaneous decrease in main and tail rotor rpm and sharp increases in main rotor drag and torque. This situation can be of such magnitude that an abrupt torque increase could overwhelm the decreased antitorque output of the tail rotor. Sharply increased power demands may temporarily exceed the engine(s) acceleration capacity. Depending on power settings, blade loading, rotor speed, true air speed, temperature, and density altitude, it may require as long as 10 seconds before engine output can motor the main and tail rotor back up to speed.

Lack of tail rotor response occurs at predicted main rotor rpm. This rpm is based on temperature, density, altitude, and gross weight parameters. Figure 1 illustrates estimated tail rotor insufficiency data for the H-3. Test stand data has been compiled from sea level to 5,000 feet at simulated speeds of 10 to 30 knots.

A tachometer gage in the cockpit indicates main rotor rpm (Nr) in percent. The importance of frequent reference to rotor rpm (Nr) during all phases of flight cannot be overstressed. Operation below rotor rpm limitations will produce a significant loss of lift, accelerated sink rate, and insufficient tail rotor thrust to offset the torque generated by the engines.

The nature of helicopter operations often requires more outside reference by the pilot than is required of his fixed wing counterpart. Liftoff, approach, and landing maneuvers in choppers often require extremes in power requirements and intense outside reference, particularly during confined area and mountainous operations. In several documented accidents, pilots became preoccupied with outside references and failed to recognize decreasing rotor rpm until the droop became excessive and they were unable to recover.

Modern fixed wing aircraft are equipped with an elaborate array of high speed and stall warning systems designed to warn the pilot when he is approaching these limits. This is not true of all helicopters. Such warning systems might well help chopper pilots avoid rotor droop and reduce accidents.

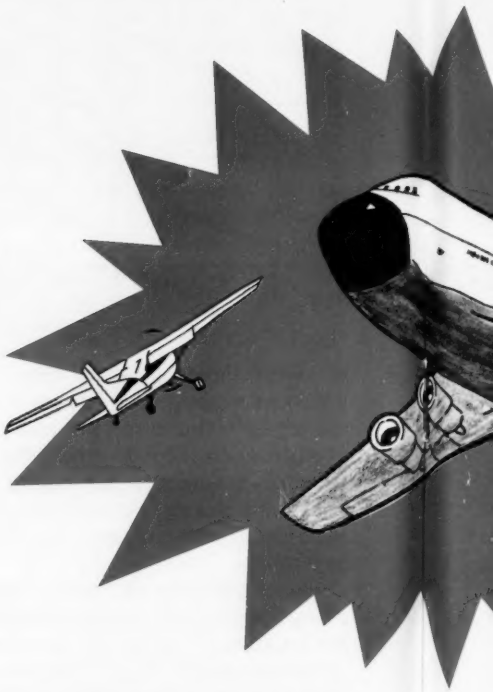
Prevention of main rotor droop and related problems is up to the pilot. He must frequently refer to cockpit rotor indications to ensure that Dash One droop limitations are not exceeded. He must be aware that the effects of high altitude, high temperatures, high gross weights and true air speed may place excessive demands on both main and tail rotor systems, the engines, and himself. Smooth collective inputs will help the engines to keep pace with the power demands of the main rotor. High rates of descent should be avoided because the power requirements of the rotor systems during level off may exceed power available. Anticipating conditions that could cause rotor droop should begin during preflight planning. The flight profile should be analyzed and performance computations must ensure that power available exceeds power required for all anticipated flight operations.

Early recognition of rotor droop is essential to safely initiate corrective actions. If rotor rpm begins to decay rapidly during high power applications, then lower collective, increase airspeed, initiate a right turn to unload the tail rotor, and go-around while there is still sufficient altitude. Attempts to salvage an approach to a hover or landing while experiencing a rotor droop will only increase chances of a prang.

The rare but ever present possibility of tail rotor ineffectiveness is but one of the hazards associated with main rotor droop. Understanding the basic physical and aerodynamic relationships of main rotor droop and its offspring is necessary before the helicopter pilot can recognize and avoid its pitfalls.

One minute the sky is clear, then you look up

Mid-Air!



by Maj George D. Burgess,
Associate Editor

Of all the potential hazards in aviation, one of the most disquieting to pilots is that of the mid-air collision.

It is ironical that, while aircrew members have an instinctive, deep-seated anxiety toward this particular peril, it usually comes as a shocking surprise to those involved. The same goes for near misses.

The ingredients necessary for a mid-air collision are many — but most are indigenous to the cockpit. It has been said that "fate" or "luck" plays a part. But these nebulous elements are no more instrumental to a mid-air than they are to landing short or banging a wing tip.

It would be very difficult to pin down any one cause of a mid-air or to identify any one sure-fire method of prevention. But the avoidance criteria begins with pilot professionalism in today's crowded sky. And that entails being aware of the associated risks.

Experience is one element which tends to keep pilots aware of various hazards. For example, if a pilot lands short once, the chances of his making this same error again are drastically reduced. But not many who have experienced mid-air collisions are around to talk about it; however, if you've ever seen or talked to anyone affected by such a disaster, you've gained some measure of experience, and you'll not forget it. That I guarantee.

Price of a Mid-Air

I remember a T-28 with radio failure and an engine problem breaking into the T-37 traffic pattern during my flight training days. Those of us in mobile control watched with horror as the intruder flew a rectangular pattern through the 360 degree overhead pattern. Its wing apparently blocked out the pilot's view of the T-37 on a tight base as the T-28 turned final. The two aircraft collided with terrific force. A few seconds later my classmate, who had been in the overhead pattern, lay dead in his burning machine. The other student was critically injured.

Around 1957 or so two airliners collided over the Grand Canyon in one of the world's most disastrous aircraft accidents. I later met a man whose entire family had been killed in that tragedy. They had been entrusted to experienced, professional pilots. Yet, the pilots somehow were unable to prevent the collision.

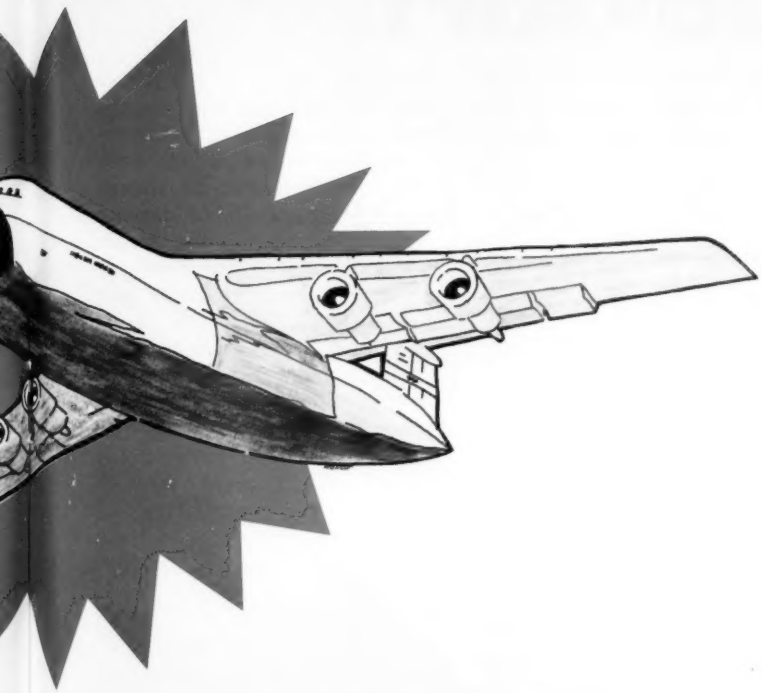
These are the type of incidents which leave impressions. But impressions tend to wane over a period of time and, sadly, the less said about mid-air collisions the more likely the chance of recurrence.

Since 1962, 195 Air Force planes have been involved in mid-air collisions. Of these, 170 experienced major damage. Three were in MAC but only one of the MAC mid-airs resulted in a major accident. We have long accepted that in the fighter business (with its high performance aircraft, close formation flying, and fewer sets of eyeballs in the cockpit) the major mid-air potential is greater than in MAC type of flying. But MAC aircraft are by no means immune. They operate in the same areas as light aircraft, in some of the world's highest density traffic areas, and under traffic controllers from New York to Karachi.

Avoidance Systems

Mid-air collision potential has prompted MAC and FAA efforts to come up with an all weather,

look up and find yourself on the verge of a...



world-wide collision avoidance system applicable to military, airline, and general aviation. A number of concepts are being considered for the system.

Tests on helicopters at Hill AFB, Utah, and Ft Wolters, Texas, showed that high intensity strobe lights are an effective anti-collision aid for slow moving aircraft. Yet to be demonstrated, however, is operational reliability of strobe devices.

Some phases of flying are particularly prone to the mid-air hazards. For instance, the traffic pattern hazard increases in proportion to the numbers of different aircraft types because speed differential complicates spacing. But in this respect, there is a referee on the ground — the tower. Tower operators use rigid safety rules designed, tested, and proven to allow orderly flow of traffic. Still, crews must keep alert to prevent nose to nose conditions in which tower control becomes a moot point. It would be a sad day, indeed, should pilots accept tower instructions without visually checking for other traffic.

Let's assume that at a given moment, the most highly qualified pilots are flying in the traffic pattern, controlled by the most highly qualified tower operators. Most of you would agree that a mid-air collision is still possible. What, then, are the other inputs into the collision spectrum?

Ground Controllers

Pilots operating under IFR and VFR receive traffic advisories, but on different frequencies. This requires third and fourth parties to get into the act. Approach control must interpret radar pictures and voice reports, and then pass this data to the aircraft. The tower operators provide cross-tell traffic information to approach control, but tower's traffic is only that which is reporting directly to the tower and that which can be visually identified from the tower. Potential human and mechanical error lie in the background of this multi-party coordination.

Visibility restrictions add or place another factor into the control problem. AFM 60-16, paragraph 7-3d, states:

> "Aircraft will not be operated under VFR to takeoff, land, or enter a traffic pattern within a control zone unless the reported ground visibility is at least three miles; and if ground visibility is not reported, unless flight visibility during landing or takeoff, or while operating in the traffic pattern is at least three miles."

Three miles seem like enough. However, at jet transport pattern speeds, this means you have only about one minute to react to avoid a fixed object; or, if your buddy is approaching you head-on, cut that time in half. That's about 30 seconds — 30 seconds to spot another aircraft, interpret it as a hazard, and decide what action is required. Then, of course, the aircraft must be maneuvered out of the flight path of the oncoming aircraft.

How about when you're instructing a new pilot? Sure, you're cross-checking outside, but you also have responsibilities inside the cockpit. By the time you spot the potential mid-air, you may have depleted much of the time you needed to respond. And, let's face it, your transport wasn't designed to respond to abrupt movements.

Visibility Criteria

Visibility plays an important

Mid-Air!

role in early recognition of a potential mid-air hazard. In recent years, traffic density has become so great that maximum utilization of IFR has been adapted as a possible solution. Again, AFM 60-16, paragraph 7-1, offers guidance to Air Force pilots:

> "Although the choice of flight rules to be followed is usually dictated by weather considerations, sound judgment plays a most important role. There are many occasions when VFR may be legally followed when applying the appropriate visibility and cloud clearance criteria, but the prerogative should be exercised with reasonable restraint. Remember, the established weather criteria are minimums. The pilot should allow himself a greater margin for safety when operational requirements permit, particularly in terminal areas or when reduced visibility or cloud conditions make flight under VFR questionable. Pilots are encouraged to file and retain an IFR clearance to the maximum extent practicable!"

This is good advice. And MAC has extended this paragraph by adding MAC Supplement One. It requires local training flights to be flown under IFR except when operating within an airport traffic area (five statute miles from the center of an airport with an operating control tower, extending up to but not including 3,000 feet), or when conducting airwork maneuvers for training or evaluation. Even then, flight to and from the airwork area must be accomplished under control of an en-route air traffic control facility. And, if possible, the airwork must be accomplished within an assigned block altitude under radar advisories.

These all add up to safer flight. Most of the time you'll be under IFR. And you'll be given traffic advisories. But the responsibility to clear outside for VFR traffic still remains with you, the crew. Potentially, a clear day can be even more dangerous than instrument weather since VFR aircraft take to the air.

Read FLIP Planning, Section Two under Arrival, Terminal Radar Programs for VFR Aircraft. It gives a breakdown of the radar service available to VFR aircraft. It shows that Stage III (Radar Sequencing and Separation Serice for VFR Aircraft) is mandatory for USAF aircraft. But keep in mind that other aircraft may not be participating in this service — another reason to keep as many sets of eyes as possible clearing outside the cockpit.

Low Altitude Traffic

Light plane traffic is concentrated primarily at low altitude. A few years ago, a C-141 flying practice instrument approaches with weather near circling minimums had its wing clipped by a private plane. The private pilot was flying around happily with a VFR clearance while the C-141 was maintaining IFR. Luckily, in this case, the light plane pilot managed to make a dead stick landing minus his prop. The transport landed safely with a ripped fuel tank. Watch out for those light planes! They may see you but they can't move fast enough to get out of your way, and you may not see them until it's too late.

Add to the low altitude environment a formation of aircraft and the chances for a disaster further increase. A formation cannot be maneuvered out of the way of another aircraft as easily as a single plane. The join-up phase of a formation requires extreme caution.

What can be done to keep proper separation between your bird and the other guy's? Since there's no fool-proof collision avoidance system in existence, it's up to you to prevent mid-airs. Here are some suggestions:

Here's How

★ Fly under IFR whenever possible, remembering that others may be following visual routes.
★ When you must fly VFR for training, use radar advisories.
★ Keep cockpit distractions down by thorough preflight briefings and follow these up with good crew discipline; monitor only one radio at a time; use extra crew members to monitor secondary frequencies; make maximum use of the autopilot to allow you more time to watch outside.
★ Whenever possible use external lights, such as landing lights and wing leading edge lights, even in daylight, to augment your silhouette and attract attention.
★ Get proper rest so that you're not slow to respond.
★ Keep looking outside the cockpit. Use scanners to help clear for other aircraft.

Follow these steps and you may just get those few extra seconds you need to see and avoid a mid-air.

Night Blindness

Dear Doc

Still another smoking hazard? Just heard that cigarettes might be what's wrong with my night vision lately. Been having some problems seeing other aircraft during the dark takeoffs. I cut down to two packs a day, but that was because of the cancer scare. Anything to this latest rumor I heard?

Nico T. Nfit, Lt Col

Dear Nico

An important but overlooked problem produced by cigarette smoking concerns the loss of night vision. In simple terms, cigarette smoke acts as a poison to the visual apparatus. The carbon monoxide present in smoke combines with hemoglobin and reduces the oxygen-carrying power of the blood. As we know from our controlled hypoxia training during chamber flights, the eye is very susceptible to lowered oxygen levels.

The term "black out" refers to the common experience that vision is impaired before consciousness under hypoxic conditions. Another common experience is that of uniformly decreased color vision and fine detail discrimination at night. All of these effects can be explained by the physiology peculiar to vision. Under dim illumination, special cells in the retina called rods are responsible for vision. Rods are extraordinarily sensitive to small amounts of light but cannot discriminate colors or fine details. Cigarette smoking can reduce rod function and night vision considerably. An aviator who is a heavy smoker can get as much as 10 percent carbon monoxide hemoglobin saturation. Only 3 percent is sufficient to cause impairment of vision and altitude tolerance. It has been demonstrated that smoking three cigarettes in a short period before takeoff will reduce night vision of a pilot by as much as the effect of 8,000 feet of altitude!

Actually the loss of night acuity in the smoker is minor, indeed, compared with the other major health problems facing him. It has been shown that, as a general rule, people who smoke lose more time from work because of illness than nonsmokers. Sudden death in males is positively correlated with length and amount of cirgarette intake and, finally, in the following diseases, smoking has been implicated as contributory: chronic pulmonary emphysema, arteriosclerotic coronary heart disease, cancer of the larynx, lips, and lungs. It is advisable for ALL people to stop smoking NOW. In light of the visual impairment potential, it is especially so for ALL aviators. Remember that CANCER CURES SMOKING.

See you around.

DOC

(4500 ABW Flying Safety Newsletter)

Jet transport lands short of the runway!

Statements like this make newspaper headlines. They also get the attention of pilots and air transport management. Everyone wants to know why it happened and whose fault it was. Let's take a look at one of the reasons — sensory illusions — and the factors behind it.

Many premature touchdowns have occurred in MAC over the years and in two recent instances the pilots and other aircrew members involved were not even aware that their aircraft had contacted terra firma prior to reaching the runway. In one case, a night approach to a sloping runway over sloping terrain, coupled with a visual transition on short final from the left to right parallel runway, resulted in a touchdown 200 feet short of the runway overrun. The weather was good and not considered a factor. In the second instance, the aircraft was on a precision approach at night and entered a rainshower on very short final. After several seconds, a rapid sink rate became apparent. Increasing aircraft pitch attitude and adding power did not prevent the aircraft from scraping the ground 1,000 feet short, causing extensive damage to the aft cargo door. In each of these cases the aircrew never lost visual contact with the approach lights and didn't perceive an unusual or low glide path picture.

Illusions or false perceptions may have contributed to these and many other mishaps. The following article reprinted from DC FLIGHT APPROACH, May 1973, addresses the illusions problem and how it affects those who fly. It has in the past, is today, and will continue to be a factor in safe air operations of the future.

* * *

The total number and percentage of jet transport approach-landing accidents increased sharply in 1972. Weather was not always a factor. In some of the accidents, the aircraft struck the ground prematurely from an apparently normal approach profile. Therefore, it can be assumed that the exposure to accidents occurred from perceptual errors.

Positioning your aircraft on final is an imp

The cockpit of a jet transport is no place for illusions.

An ever-increasing number of approaches are being made to airports without vertical guidance. Operational trends have been to lower the weather minimums, thus resulting in more approaches under conditions of deteriorated visibility. It also appears inevitable that the pressures for noise abatement will result in steeper approaches, further taxing the senses of flight crews in final spatial positioning during the approach. The exposure to "black hole" approaches will sharply increase as more airports adopt newly devised noise abatement procedures.

Undershooting

We cannot define the number of accidents which have occurred as a result of sensory illusion. But we do know that at least 45 undershoot accidents occurred with jet transports (worldwide) since 1966; almost half of these were fatal. Collision with surrounding terrain during initial approach added about 15 more. This type of accident is frequently the most

difficult for cause determination. It is not our purpose to assign causes, only to affirm that trends show the need for a review of sensory illusions, and of the defenses which can be used against them. An awareness of the conditions which produce susceptibility to illusory phenomena is a necessary vaccine.

In the interests of air transportation safety, it is possible to draw from and acknowledge existing sources of material and research on the subject. We have chosen to limit this article to a review of those conditions of disorientation or other related phenomena which expose flight crews to approach-landing accidents. Because of the unique flying requirements, the pilot must spatially maneuver and exactingly position the aircraft through visual interpretation from all available references. However, our principal dependence on vision is biased by other sensory and psychological cues. In fact, in extreme cases, it can be so influenced as to cause hallucination without drugs. What you see is not always what you get.

Sensory Illusion

The approach phase of flight is particularly susceptible to sensory illusion, yet the pilot may not even realize that he is experiencing it. Illusory effects should be anticipated and guarded against as discussed in the subsequent paragraphs.

Visibility Restrictions — You will appear to be higher than you actually are in conditions of darkness, haze, smoke and glare. It must be remembered that shadows aid depth perception; when they are missing, due to visibility restriction, altitude is interpreted by the senses as being higher because shadows are not discerned. The effect is most pronounced during dark-night landings or when haze or smoke layers lay low across the threshold. Under these conditions, straight-in VFR approaches may cause the pilot greater illusory effect than from approaches conducted from a downwind-base leg entry.

To counteract these effects, a precision glide path rate of descent should be maintained to touchdown. A proper use of altitude callout procedures and altimeter cross-checking will assist the pilot in offsetting the illusory effect.

Runway Characteristics—Lighting, Slope, Dimensions, Contrast — If runway lights are dim, the pilot can expect to appear higher and farther from the runway than actual. On straight-in, clear-night approaches, one may appear to be closer than actual. The illusion is that bright lights or bold colors advance and that dim or dull ones recede. The effect is most pronounced in cold-clear air or approaching over an unlighted (desert or water) surface. Absence of approach-zone lighting increases the exposure to illusion.

Counteracting Illusions

To counteract these characteristics, the pilot should familiarize himself with the type of lighting and follow the published instrument or visual approach procedures. The precision glide path should be used when available. Increased attention to cockpit instrumentation and regular callouts of deviations from the proper

an important task and the cockpit is...

OR ILLUSIONS

A sloping runway can produce illusions.

glide path greatly negate any illusory effects.

The aircraft will seem to be higher than it actually is if the approach zone terrain slopes upward toward the threshold. Conversely, if the approach zone terrain slopes downward, the normal glide path will seem too flat, or the aircraft will appear to be lower than actual. The exposure to hazard from this sloping threshold terrain illusion may be amplified by far runway end terrain or a desire to touch down near the approach end. Correcting for the illusion of the upward sloping terrain can result in an undershoot.

Moreover, runway slope tends to create an illusory effect since we inherently assess our approach path in relation to the normal ILS or VASI path. With an upslope condition, the glide path appears steeper, causing a tendency to fly a low approach. On the other hand, with a downslope condition, the glide path appears to be lower, causing a tendency to fly a steep approach.

To counteract such conditions, you should familiarize yourself with runway-slope characteristics during flight planning. A precision glide path should be followed to touchdown when you are unfamiliar with the runway.

Relative runway dimensions may affect the senses during approach because we relate to a normal or expected scene. On a shorter runway, with identical proportion (length-to-width), the tendency is to judge the aircraft to be farther out and, therefore, higher than normal.

It is preferable to determine the runway proportion by viewing it down the centerline and obtaining a proper perspective, rather than from an oblique angle which would possibly cause distortion.

Lack of runway contrast with surrounding terrain presents an illusion which affects depth perception. Extreme examples are a snow-covered runway, a night landing on a dimly lit runway, or any lack of color contrast. As previously discussed, visibility restrictions also reduce the runway-terrain contrast; all of which can add up to an undershoot or overshoot.

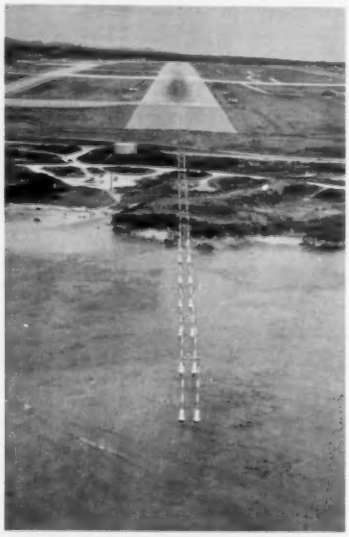
Under these runway-terrain contrast conditions, you should exercise caution and be prepared to go around. A precision approach, if available, should be utilized to minimize the effect.

What You Expect

Everyone has expectations (or motivations) which influence the correlation of what he sees. This human characteristic can result in an expectant attitude so pronounced as to cause a person to see something wrong, but to take it at face value for what he wanted or expected to see. Such an attitude must be kept out of the cockpit. Yet, we have read of illusory cases of time and marker beacon passage which did not agree with actual position, and of actual landings at wrong airports.

Fatigue can also affect proper responses to stimuli. A tired individual is prone to overlook or disregard indications that require a response. This can be a subtle incapacitation. It is also known that the eyes experience a sort of fatigue where a constant (steady) stimulus can reduce an individual's perceptive ability to virtually zero. In other words, the eyes have recorded a phenomenon so long that the individual can be almost blind to a need for action.

In addition to poor visibility, there is a refraction error in vision while flying in rain which causes the eye to indicate a horizon below the true horizon. The error, including effect of reduced transparency of the windshield, may cause objects to appear lower than they are by as



Depth perception cues are fewer when approaching over water, snow, and other noncontrasting surfaces.

much as five degrees or 200 feet at one mile.

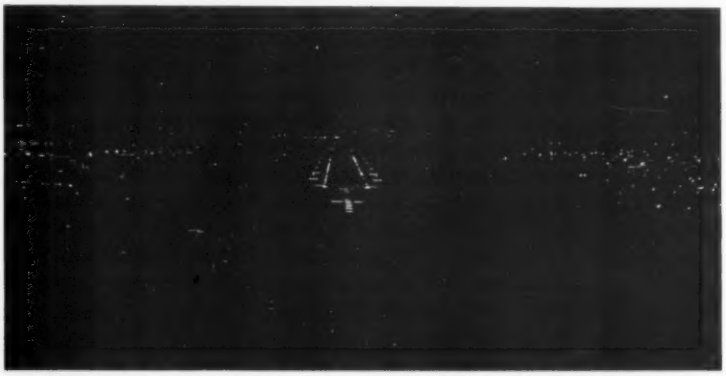
The flight crew should use altimeter cross checks and altitude callout procedures because this phenomenon presents the greatest hazard on final approach after breaking out at the base of a ceiling.

False Horizon — An insidious illusion can be expected on dark nights when surface lights are not visible, and a steady light comes into view suddenly. The light can dominate a pilot's vision and appear to be a star or planet; particularly, if he has just broken into the clear. If the light is forward of the airplane, a pilot may have an overwhelming visual sensation that the light is above the horizon, and that the nose of the aircraft should be pointed below the light. An uncomfortable illusion of climbing has been experienced by pilots under this situation even though they continued to fly a straight and level course.

Fully automated approaches and landings will some day be routine, but until that time the foregoing conditions must be expected and guarded against, even in the flight planning stage.

Fly Precision Approaches

Flight crews should exercise extra vigilance with the compounded illusory potential of the "black hole" approach, such as over water or unlighted terrain, toward well-lighted cities and airports. With additional airport utilization, night VFR approaches can be expected to increase, resulting in more exposure to the "black hole" conditions. We emphasize that illusions and their effects can be minimized by procedural use of cockpit instrumentation and by awareness of the special problems associated with such approaches. Precision, ILS, or VASI approaches should be used whenever possible. When conducting approaches to non-instrumented runways (non-ILS or VASI), a three-degree flight path can be fairly and accurately flown by use of airborne equipment and ground aids. Top of the descent fix and the distance to the runway can be obtained and monitored throughout the approach by reference to TVOR (DME), ILS (DME), INS (Dual Check), Doppler (Dual Check), VOR (Cross Radial Check). Altitude for the approximately three-degree flight path angle can then be monitored by a "rule of thumb" method of figuring (3 times the distance times 100) Altitude (feet) = Distance (NM) × (3)(100). Here are some examples: 150 feet = ½ NM; 300 feet = 1 NM; 600 feet = 2 NM; 900 feet = 3 NM; 1200 feet = 4 NM; and 1500 feet = 5 NM.



The "black hole" approach is an open door for deceptive illusions.

The common defense against the perceptual threats is equally effective for approach-landing or altitude-related accident preventions. They are (1) increased use of cockpit instrumentation and of altitude warning or alert systems; (2) establishment of a precision approach flight path to touchdown from airborne and ground aids which are available; and (3) emphasis on crew coordination and discipline.

Much promise is offered for reducing the hazard of the sensory illusion problem associated with flight. Use of the autocoupled approach and of the Autoland System is gaining prominence with equipment in newer jet transports.

Area Navigation (RNAV) equipment has been developed and is scheduled to replace (between 1975 and 1982) the present VOR structure; it will then be required for operation in controlled airspace. Present day inertial guidance equipment allows worldwide navigation from takeoff to final approach, based on radio and inertial data. The system provides three dimensional operation during automatic tracking of departures and arrivals, down to nonprecision minimums, and followed by missed approach to alternate.

Since the eyes, however, remain the predominant sense which provides the link between the aircraft and its environment, illusions must always be expected as a part of flying. Unless counteracted, the sensory illusion may initiate a sequence which could result in an incident or, worse yet, an accident.

A long, white runway—perfect ingredients for a survival situation with C. R. at the helm.

C.R. TERROR

C. R. hunched over in the left seat. The familiar black cigarette holder was not at its accustomed jaunty angle and even the finely waxed mustache appeared to droop a bit dispiritedly. A trace of "Balm de Tigre," an imported Parisian talc, was visible on the right jowl — a slovenly touch quite unlike the dapper AC.

Long Suffering Sam had been eyeing the boss furtively since liftoff at Elmendorf and, frankly, he was baffled. Recalling the mad dash through command post, weather and base ops — locally known as the "Terror 500" (yardage measured door to door) — Sam could recall nothing to justify Terror's extreme moroseness.

Finally Sam cleared his throat, leaned over confidentially and humbly in the manner of well-trained copilots the world over, and said hesitantly, "Boss, you feel okay? You got some trouble maybe, like the kind that comes with long legs and tight sweaters?"

Sam had succeeded in his efforts. A thought had been implanted in the Terror cerebrum. A slow smile curved his lips.

"No, Sammy, nothing like that. Although in my present mood, I would be especially effective with an approach I have come to call "The-Sad-Man-of-the-World-Who-Has-Seen-Too-Much" technique. Works especially well with compassionate or motherly damsels. I recall one situation in Des Moines when . . . ."

Without turning his head, C. R. suddenly roared, "Blinky, get back to your desk! You're too young for such stories."

The startled navigator who had crept stealthily forward when he first saw the smile on his AC's face, turned and beat a hasty retreat to his crew station. "Darn it, I never get to hear the really good stories," he muttered. "If he could sense other airplanes the way he does when I come around, we'd have the mid-air collision problem licked." Then a thought brightened his outlook. "Oh well. Someday maybe I'll get to be an old captain like Sam. Then I'll find out what Maj Terror does on crew rest."

The subject of Blinky's thoughts had meanwhile reverted C. R. to his earlier mood. "Look at that sun, Sammy," he commanded.

"How can I miss it? It's right in the middle of the windshield where it always is."

"Yeah, but look how low it is. Next trip we'll see snow on the runway. Then it gets colder. And cold and snow and night are all we see for the next six months."

"Well, sure," replied the copilot, "but it does that every year.

You figure on changing things?"

Terror ignored the barb. "That's what I mean. Same thing every year. 'Get ready for winter,' they say. 'Look out, it's getting cold outside,' they say. Heck, I know it's cold outside first thing I get up in the morning. I am very clever that way." He paused in his monologue to draw fresh breath.

"Meanwhile, back in civilized parts," he went on, "the Harvards and the Yales are girding for battle on the gridiron. The only time of the year when you can walk down the street with a blonde on one arm, a blanket on the other, and no questions asked. A big yellow mum on your doll's coat,

a small silver flask in your coat, bands playing . . . ."

"I hear there's an athletic contest of some kind on the field at the same time as your main event in the stands," interrupted Sam, getting a little bumptious because of his previous success.

"It's good, Sammy, that your mind is small. It goes so well with your meager rank." C. R. could be cruel at times.

Sam cussed himself and subsided.

"And what am I doing while all these fun and games are underway?" C. R. continued. "I'll tell you what I'm doing. I am driving 150 tons of assorted aluminum and steel, filled with various lethal fluids, in a northerly direction. North, mind you. Not south where birds, bees, and bikinis go. Enough to make a guy sick." He slumped deeper in his seat, hung his headset well out of the way, pulled the green eyeshade over his eyes, mumbled to Sam, "You got it."

"You mean I've had it — for the last two hours," retorted Sam, but he said it only to himself and quietly at that. Sam seldom got bit more than once a trip any more.

Some time later Terror awoke from what he liked to call his "enroute cat nap to refresh one's eyes and senses for the demands of the approach and landing." His temper was little better. "Blinky," he snarled into the interphone. "Where are we?"

Forewarned by the snorts, bellows, wheezes, and thrashings which preceded a Terror awakening (a new engineer, back in the C-124 days, had once feathered two on the same side upon his first exposure to the phenomenon). Blinky was ready.

"Pilot, this is navigator. Estimating Daigo at one niner four five zulu, Nikko at one niner four niner, blocks of two zero two one. Navigator, over and out."

"Now, ain't that pretty," said C. R. "If they remake 'Twelve O'Clock High' I'll keep you in mind. Sam, what's the weather?"

"Just got it," answered the copilot. "It's snowing with about 800 foot ceiling, 2 miles visibility in . . . ."

"Whaddaya mean, snowing," screamed Terror. "It doesn't snow in Japan!"

"Well, the weatherman in Elmendorf did mention the possibility. He didn't have enough data to make a positive prediction, but he suggested we keep a close eye on the situation on account of things can change pretty fast about this time of the year."

"Nice of 'em to tell us about it this late," snorted C. R.

"They did tell us a long time ago. But you said to never bother you unless more than one was shut down. Besides, the field's well above minimums and the wind is light."

"Okay, okay, 'sall right anyway. Still a piece of cake. They don't call me the Arctic Fox for nothin'. I been needin' sumpin' to pose a challenge to my aviatin' skill." He seized the yoke enthusiastically. "Tallyho, and away we go. Look at me hold this heading, boy."

"Perfect," said Sam dutifully. And after a short pause, "Are you going to take it off autopilot before we land?"

The big transport bored on in. Sam remembered the anti-ice equipment, and eased the power up to maintain 71 percent N1 rpm. The GCA operator was a pretty sharp cookie and stayed ahead of his target's meanderings. (C. R. never held a precise heading. "It's only an approach aid," he would explain. "I will vector myself to the runway when

I break out visual.")

They were just inside the outer marker when Sam called the runway in sight.

"What'd I tell you, boy. Like shootin' fish in a barrel. A cinch for an old Arctic hand like myself." Terror was exhilarated.

Touchdown on the powdery snow was abnormally smooth. "How about that? Neat, heh? Now I'll reverse her and make that first turn off. Yowee, help! Sam, Sam. I'm blinded! I'm coming out of reverse."

There was a crunch, a hunch, another crunch. Then as the forward visibility improved, C. R. straightened the big bird out, located the runway edge lights, and made his way back to the area used by most pilots for landing. The aircraft slowed, stopped. Crash trucks, called out by an alert tower operator, swarmed around.

Some minutes later, C. R. was advised by command post that the base commander desired to speak with him. And some more minutes later, C. R. found himself in a familiar position — braced firmly in front of the desk of a tight-lipped man wearing eagles.

"Major," said the colonel. "Since my arrival here, I have formed the greatest respect for the average MAC aircrew. They do a superb job, often under trying conditions. However, as sure as the first snow of winter, the first accident is caused by an over-confident pilot who knows so much about cold weather operations that he doesn't have to review the special techniques and precautions required for safe winter operations. With 11,000 feet of runway, I find it difficult to believe that excessive reversing was required. Did it ever occur to you that reversing on dry snow would certainly create visibility problems?"

"Well, Colonel, as a matter of fact, it had, just momentarily, slipped my mind that . . . ."

The Colonel raised his hand. "Say no more, Major. It looks like your mistake will not wind up in the accident category. You can thank a wide runway and good shoulders for that. On a narrow strip, I have no doubts that you'd have cost MAC a valuable aircraft. However, I'm going to do my best to make arrangements for you to buy a C-141 tire and a couple of runway lights. That will be all, Major."

It was a silent crew that finally pulled up to the transient crew quarters. They walked through the gloom to the door. The tall thin fellow in front opened the door and waited for the rotund little man beside him to enter. But C. R. Terror made no move. "You go ahead," he said as he looked at the snow covering the ground. "I'm going to stay right here. I dislike this stuff so much I'm going to stay right here so I can watch it melt. Besides, the first round is on you for not anticipating that blowing snow job you got me into."

Unscheduled Drag

Drag is a basic part of every airplane. But as all pilots know, the airframe is designed to create a minimum of airflow turbulence.

So, when an aircraft's skin is torn, the resulting drag device creates turbulence problems of varying proportions.

On a jumbo jet recently, a skin tear developed on a panel attached adjacent to the right aileron. The turbulent airflow from the tear was directed toward the control surface, creating the need for unusually large amounts of trim changes and finally causing cracks in the aileron. Fortunately, the cracks were discovered in time to prevent major problems.

When you discover tears in an airframe, be sure that maintenance checks it out. What may look like a small thing could be a serious problem later.

Job Half Done

The turboprop was two and one-half hours into its mission when the engineer, making a routine check, discovered that the left main landing gear door was not closed.

The pilot immediately slowed the aircraft and made an uneventful landing at an enroute base. When the aircraft was parked, the crew deplaned to inspect the door for possible damage and the cause of the malfunction.

They found that the left landing gear door quick release locking pin had been improperly installed during preflight inspection. It had been secured through the left main landing gear door operating mechanism bracket but had not been secured through the left main landing gear door mechanism rod assembly. The result? The door could not close when actuated. Further inspection revealed that the left wheel well aft mud guard and fuselage panels were cracked and damaged.

How could that have happened?

The flight engineer somehow had managed to install the pin improperly, thinking he was performing this routine task the same as he had on numerous prior occasions.

Mod FOD

Engine change. A result of foreign object damage to a jet engine. The cost? Thousands of dollars in time and materials.

The aircraft was being ground run following the removal and replacement of an oil pressure regulator. At 97 percent, the engine's compressor began to stall. It was shut down and a thorough inspection begun. A metal can opener was found in the ninth stage of the compressor.

FOD programs have been in existence for years, yet FOD damage continues due to carelessness. No one group of individuals can prevent FOD damage, but it only takes one person to cause it. The next time you're on the line for an extended period, try looking around for FOD. You might

even check your bags. Could you be missing your soda opener?

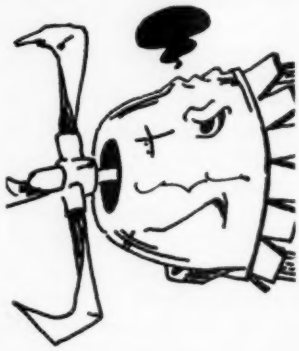
Qs

Phantom Fire Extinguisher

The four-engine transport was beginning to taxi when the crew heard a bump resembling a backfire. Engine inspection revealed no malfunction. The aircraft was aborted due to a faulty radar, and the mission continued with the spare aircraft.

The following day, the aborted aircraft was flown on another mission. While it was airborne, a maintenance man noticed that the fire extinguisher near the vacated parking spot had a three-sixteenths of an inch cut in its round handle.

When the flight crew landed, the maintenance team inspected the aircraft to see if it had struck the



fire extinguisher. The inspection revealed slightly deformed tips on two blades of number three propeller. No other damage could be found.

As further investigation continues, procedures have been changed to make it mandatory for a maintenance man to stand fireguard during engine start and taxi out. Also, the flight engineers are being rebriefed on the meaning of the response to the checklist challenge, "Ground Clearance."

Breath-taking

A crew recently discovered why oxygen procedures are stressed for high flying aircraft. They were jetting away in a normal climbout when the left pressurization pack began to squeal. After deciding the noise didn't fit into the normal mix of decibels, the pack was shut down. The noise stopped.

As the climb continued, another noise rang out. This time it was the engineer yelling that the pressurization was not holding in the aircraft. By this time, they were above 20,000 feet and pressurization was mandatory.

The left pack was restarted, the noise returned, but the pack would not maintain cabin pressure. The engineer then found that the right pack was also malfunctioning. With both packs "on," the cabin pressure was still rising rapidly.

To add further excitement to the emergency, the oxygen system did not come on as the cabin pressure passed through 13,500 feet. So, the system was turned on manually.

Quickly obtaining ATC clearances, the aircraft descended to denser air with no further discomfort or danger.

Investigation revealed there had been dual pack failure and that the automatic oxygen function was faulty. Quite a compound problem. But this crew had been trained properly, and, consequently, handled the dangerous situation well.

This incident is a vivid reminder to practice and rehearse emergency oxygen procedures often.

Mistaken Communication

Communication is a key to crew discipline. And crew discipline is essential to safe flight. When communication breaks down and discipline falters, disaster lurks close by.

An instructor and student floated down smoothly following their safe ejection from a tandem jet. Why had they ejected? Neither was quite sure. The rear cockpit interphone had gone out shortly after a minor aircraft malfunction and the instructor signaled the student that he would take control of the plane. The student misinterpreted the instructor's intentions and would not relinquish control, opposing the instructor's attempts to take over. The instructor thought the flight controls

were frozen and ordered bailout. This time the student didn't misinterpret the command. Both pilots landed without injury, but the multi-million dollar aircraft was destroyed.

MAC's aircraft have the pilots sitting side-by-side, so this type of communications failure is not as likely to happen. A more prevalent problem in MAC is the communications failure between the aircraft commander and crew members in the cabin. Communications and discipline are just as important for transport aircraft as for the supersonic machines.

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"NOW LET'S GET OUR STORY STRAIGHT, RIGHT ABOUT HERE WE REMEMBERED THE GENERALS' HIBACHI POT."

after deadline . . . .

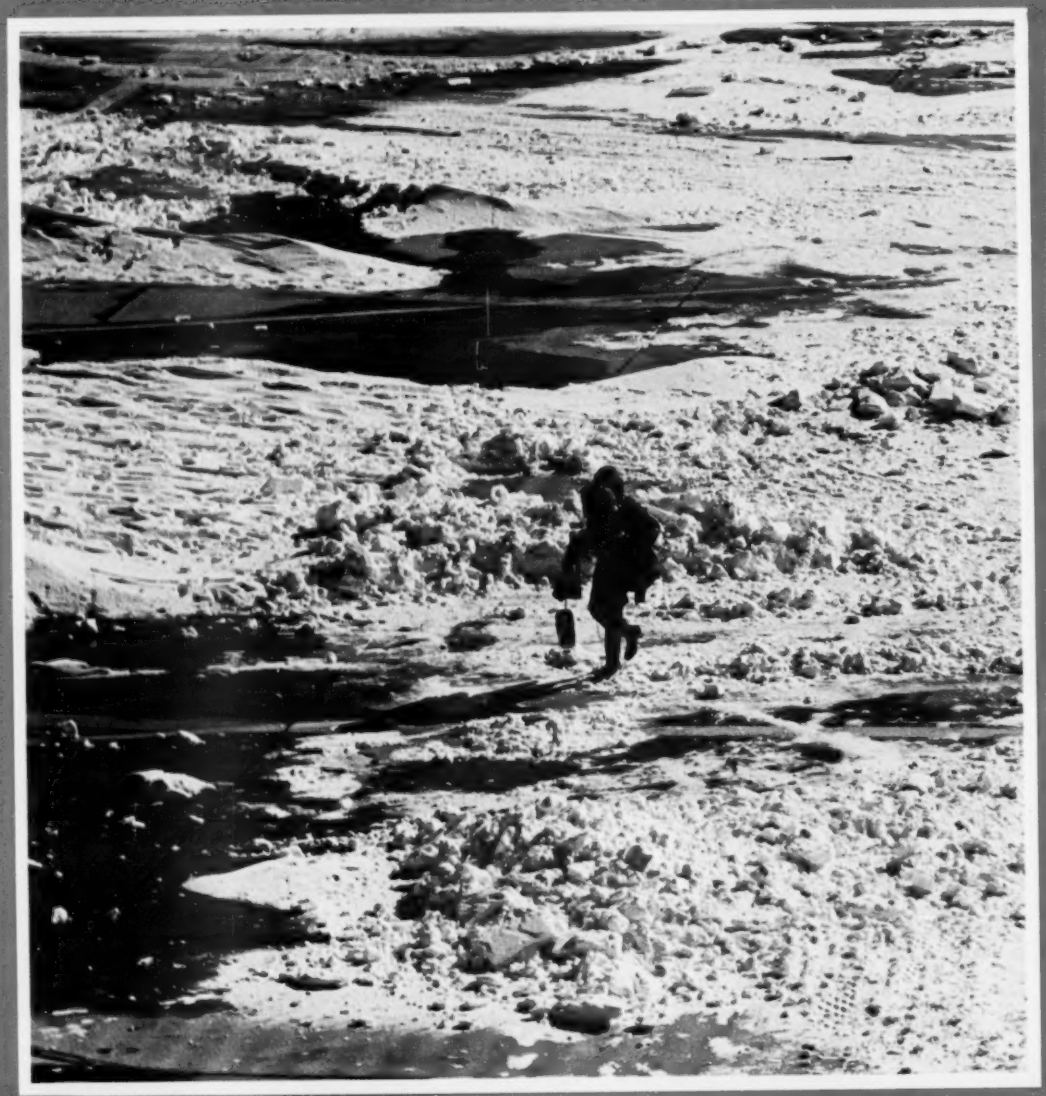
ALL REPLACES PRIMARY -- The "primary cause" has been abolished as an accident cause factor determination.

Replacing it, as of 1 Oct 1973, is a new approach which the Office of Aerospace Safety feels will prompt more thorough accident investigations.

The new system calls for replacing the "primary cause" with a sequential listing of all causes contributing to an accident. Top Air Force safety officers believe this newer method will allow accident boards to address all interacting causes which may have played significant roles in an accident. Under the old system, important contributing causes were sometimes obscured in the search for the all important "primary cause."

Largely because of the human decision involved in defining "primary cause," it had become a subject of debate among safety officers and line pilots alike. Rules for cause determination remain unchanged.

In essence, the deletion of the "primary" and "contributing" cause labels simply allows total emphasis on each cause rather than only one.

INCREASED PRICES -- We just received notice from The Superintendent of Documents, U. S. Government Printing Office, that the annual Flyer subscription will increase after 1 January 1974. If your subscription is received by the GPO before 1 Jan, the rates will be as printed on page 31. Any subscription received after 1 Jan will be $5.35 for stateside mailings and $6.60 for overseas.

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